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How Does Digital Finance Affect Carbon Emissions? Evidence from an Emerging Market

Hui Zhao [1,†], Yaru Yang [2,†], Ning Li [3,†], Desheng Liu [2,*,†] and Hui Li [4,†]

1 School of Finance, Qilu University of Technology (Shandong Academy of Sciences), Jinan 250353, China; crystalzhaohui@163.com
2 School of Management, Qilu University of Technology (Shandong Academy of Sciences), Jinan 250353, China; 17854119921@163.com
3 Business School, University of Jinan, Jinan 510632, China; log_lining@163.com
4 Stuart School of Business, Illinois Institute of Technology, Chicago, IL 60661, USA; hli30@hawk.iit.edu
* Correspondence: liudesheng_qlu@163.com or liudesheng@qlu.edu.cn
† These authors contributed equally to this work.

Abstract: The existing literature finds that finance has a significant impact on carbon emissions, but there is a lack of theoretical explanation on whether and how digital finance, an important new financial form, affects carbon emissions. This paper uses balanced panel data at the provincial level in China from 2011 to 2018 as a sample to empirically test the relationship between digital finance and carbon emissions and introduces three exogenous events to test the impact of policy shocks. The results show that digital finance has a significant inhibitory effect on carbon emissions; the implementation of the policies of 'G20 High-Level Principles for Digital Financial Inclusion', 'Environmental Protection Tax Law of the People's Republic of China', and 'Interim measures for the management of greenhouse gas voluntary emission reduction' strengthens the suppression of carbon emissions by digital finance, and the robustness test also supports the protection of digital finance. The research conclusions of this article provide theoretical evidence for understanding the relationship between digital finance and other new financial formats and carbon emissions and provide an empirical basis for policy-makers to promote the development of digital finance to reduce carbon emissions.

Keywords: digital finance; carbon emission; policy guidance; location difference

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1. Introduction

Population expansion and the continuous increase in energy demand increase environmental damage [1]. The Limits to Growth, published by the Club of Rome in 1972, sounds the alarm for human development by showing the limits to the self-healing ability of ecosystems and the potentially serious consequences of the excessive pursuit of wealth growth. Among many environmental issues, climate warming as a global event has aroused widespread concern from all walks of life. The fifth assessment report released by the IPCC pointed out that one of the most important reasons for the greenhouse effect is that the emission of a large number of carbon compounds generated by human activities in the past two centuries has led to the concentration of greenhouse gases such as carbon dioxide in the atmosphere rising sharply [2,3]. The world CO_2 emissions by sector data released by IEA show that the CO_2 emissions of electricity and heat producers, transport, and industry account for a large proportion and the overall trend is increasing; data from the Statistical Review of World Energy released by BP show that global carbon emissions have increased by approximately 5 billion tons in the past ten years, of which carbon dioxide emissions in the entirety of the Asia Pacific are significantly higher than those in other regions (relevant data and charts can be requested from the corresponding author). Melting ice sheets, extreme weather [4], and the accelerated spread of infectious diseases are all closely related to the increase in carbon emissions, posing a great threat to the Earth's ecology [5]. Carbon emissions are mainly used in production activities aimed at achieving economic growth; that is, economic growth is based on the cost of carbon emissions. Achieving a win–win situation between carbon emission reduction and economic growth has become an important issue for global development. The feasibility of achieving economic growth under carbon emission reduction has been confirmed in the UK. The data released by the British government show that, from 1990 to 2019, the GDP of the UK increased by as much as 75%, and greenhouse gas emissions fell by 43%. In the longer term, evidence shows that carbon emission reduction will not cause huge resistance to GDP growth.

As the world's largest energy consumer [6], China's long-term inefficient model of economic growth [7] shows serious drawbacks in many aspects. In recent years, the Chinese government has made active attempts to promote economic development and ecological balance and has achieved good results. The carbon intensity at the end of the thirteenth Five-Year Plan dropped by 18% compared with 2015. The results of the Ninth National Forest Resources Inventory (2014–2018) show that China's forest area is 220 million hectares and that the total carbon reserves reach 9.186 billion tons. In addition, the Chinese government takes many measures to enhance the innovative application of financial instruments. For example, in 2011, pilot projects for carbon emission trading were carried out in multiple regions, the national carbon emission trading market was opened in July 2021, and the implementation of the Green-Credit Policy encouraged enterprises to actively protect the ecological environment. Technological progress is a decisive factor in promoting sustained economic growth [8]. To further give play to the important role of finance in resource allocation, China actively promotes the in-depth application of modern information technology tools such as big data and cloud computing in the financial system to drive the development of the new financial format of digital finance. The internetization of the financial industry significantly improves the efficiency of financial resource allocation and reduces the degree of market information asymmetry [9]. Digital finance has the advantages of low cost, low threshold, high efficiency, and great flexibility [10]. The development of finance reduces the external financing cost of enterprises and other subjects [11], and new financing channels with lower capital requirements provide advantageous financial support for enterprises and other energy-consuming parties to transform production models and reduce carbon emissions. The existing literature can confirm that financial development is conducive to improving environmental quality [12], and it is an important driving force for renewable energy consumption [13]. However, does digital finance have a significant impact on reducing carbon emissions? How do policies affect the relationship between digital finance and carbon emissions? These problems still lack effective explanations in theory. To this end, this paper analyzes the aforementioned issues, reveals the internal reasons for the suppression of carbon emissions by digital finance, and considers the differential impact of policy events on the relationship between digital finance and carbon emissions.

The remainder of this paper is organized as follows. Section 2 briefly reviews the relevant literature and proposes the research hypothesis; Section 3 includes the data and methods; Section 4 presents the empirical results; Section 5 reports the results of placebo test robustness; heterogeneity test results are presented in Section 6; and Section 7 summarizes the main conclusions and proposes policy implications.

2. Literature Review and Research Hypothesis

2.1. Literature Review

The impact of finance on environmental pollution or carbon emissions is receiving extensive attention from academia. The large-scale and in-depth applications of digital finance have concentrated in recent years, and the current research on the impact of digital finance on carbon emissions is insufficient. This paper studies the existence and direction of digital finance's effect on carbon emissions on the basis of combining the impact of finance on environmental pollution and carbon emissions.

In the early 1990s, Grossman and Krueger proposed the Environmental Kuznets Curve on the relationship between the level of economic development and environmental pollution. The environmental pollution problem became more serious with the rise of the economic development level, and after the per capita income level reached a certain value, the environmental pollution problem could be alleviated; that is, there was an 'inverted U-shaped' relationship. Tamazian and Rao [14] confirmed the existence of the EKC by using panel data of 24 transition economies from 1993 to 2004 as samples; among the 181 countries sampled by Narayan et al. [15], there was an EKC relationship between economic growth and carbon emissions in 21 countries. Using China's data as a research sample, a similar phenomenon was also found: Zhu [16] pointed out that when the financial development level is low, economic growth is positively correlated with the degree of environmental pollution, and the opposite is true when financial development is at a medium-to-high level; Hu and Wang [17] empirically tested the 'inverted U-shaped' relationship between financial development and carbon emissions, and financial development can suppress carbon emissions by promoting technological innovation.

In addition to the 'inverted U-shaped' relationship, there are two one-way views. First, Usama and Che [18] empirically analyzed that economic and financial development will aggravate pollution, and economic growth actually stimulates carbon emissions [19]. This result will be produced when the development of the financial system makes the wealth and scale effects of finance greater than the technological and structural effects [20]. The development of finance alleviates financing constraints, and the large amount of investment in energy-intensive and highly polluting projects made by enterprises in pursuit of high profits has a serious negative impact on the environment [21]. The increased energy consumption brought by the increase in output increases carbon emissions [22]. Financial development also stimulates consumption, which can be manifested in expanding the scale of household credit in emerging economies, encouraging consumers to purchase energy-intensive goods and increasing carbon emissions [23]. Second, financial development can reduce carbon emissions and improve environmental quality [24]. Countries with more developed financial systems can reduce pollutant emissions through technological innovation [25], and financial development can promote economic growth while reducing environmental pollution [26], such as encouraging companies to use clean energy to reduce carbon emissions [27]. Shahbaz et al. [28] studied Malaysian data from 1971 to 2011 and confirmed that there is a long-term equilibrium relationship between finance and carbon emissions and that financial development alleviated the pressure on carbon emissions.

The positivity of the system is related to the environment and output [29]; a strong system can reduce deforestation [30], and a weak system can lead to species extinction and the destruction of biological habitats [31]. Policies can increase pollution production and treatment costs by setting standards and levying taxes and encouraging the use of clean energy. Factors such as high costs and greater policy uncertainty prevent capital from entering high-polluting and high-energy-consuming industries. Tamazian and Rao (2010) [14] studied the situation of the Soviet Union and Eastern European countries and confirmed that strong government mechanisms can promote the suppression of environmental pollution by finance. In theory, policies will promote better changes in the overall environmental conditions, but in reality, there may be a green paradox. With the tightening of policy constraints, fossil energy miners expect to be more constrained in the future, so they tend to push forward their future mining plans to avoid risks and increase expected returns. In the short term, the increase in fossil energy mining will cause the price to fall, which will stimulate large purchases on the demand side, which will increase carbon emissions. Di et al. [32] found that after the United States implemented the Clean Air Act Amendments in 1990, the coal price dropped significantly. Regarding the impact of macro policies, many scholars adopt the method of introducing policy dummy variables to conduct research [33].

The aforementioned literature shows that there are diversified conclusions about the impact of finance on environmental changes or carbon emissions, but there are still deficiencies in the research on digital finance. This article takes the development of digital finance in China as the background to study the impact of digital finance on carbon emissions and the changes brought about by the implementation of relevant policies, with a view to providing reference experience for countries to guide the policy choices of financial and economic development.

2.2. Research Hypothesis

CO_2 is an additional product in the production and consumption process. Mitigating the negative impact of carbon emissions requires considerable manpower and material resources, and the production side and consumption side seldom voluntarily achieve carbon emission reduction through technological improvement, transformation, and upgrading. The economic and social development of various countries is accompanied by a large amount of carbon emissions. Some scholars select various samples from different research perspectives to explore the role of finance on carbon emissions, but the current research on digital finance still needs to be supplemented. This paper, combined with the number of samples of financial applications and the actual situation of carbon emissions change by reasoning, proposes Hypotheses 1 and 2, respectively.

2.2.1. Digital Finance Promotes Carbon Emissions

There are four main reasons that digital finance can promote carbon emissions.

First, powerful information analysis and processing capabilities are financially attractive. The typical breakthrough of digital finance compared with traditional finance is the use of artificial intelligence, big data, distributed technology, etc., to achieve the low-cost, low-risk processing of massive data [34], and scientific risk analysis and forecasting methods are uniquely attractive to investors. After financing constraints are eased, many industrial and manufacturing companies will provide funding conditions for the expansion of factories and marketing activities.

Second, large-scale and differentiated firms attract foreign investment. At present, the scale of development for financing and application scenarios of China's digital finance is in a leading position in the world, and its main business focus is on mobile payment, online lending, online investment, etc. The advantages of large-scale and differentiated development attract foreign investment, economic scale expansion, and increased energy demand.

Third, some regions are developing at a fast pace. There is a significant imbalance in development among regions in China. Digital finance uses technological means to break through the limitations of time and space to bring low-cost and diversified financial services to remote areas, and income regions tend to invest in extensive production areas that can benefit from short-term investment.

Fourth, there is the broadening of consumer loan channels. The simple operation and low threshold of access to funds of digital finance make purchase behavior more in line with the consumption concept of contemporary individual consumers, and the acquisition of intertemporal spending power encourages consumers' propensity to purchase and replace large consumer goods.

In view of the above analysis, we therefore propose:

Hypothesis 1 (H1). *The development of digital finance promotes the growth of carbon emissions.*

2.2.2. Digital Finance Has a Depressing Effect on Carbon Emissions

There are three main reasons that digital finance has an inhibitory effect on carbon emissions.

First, digital finance supports technological progress. Financial development promotes economic growth and reduces environmental pollution [26]. After technological progress reaches a sufficient level, a good environment and economic growth can coexist and be prosperous [35]. An important reason for the high carbon emissions is the inefficient use of resources due to low technology. Improving green technology is a risky and long-term capital-intensive investment behavior, and companies face severe financing constraints in an environment of poor financial development [36]. On the one hand, the improvement of domestic fund shortages by digital financial applications strongly supports independent research and the development of carbon emission reduction and carbon capture and storage technologies, and promotes cleaner production and the use of carbon elements. On the other hand, FDI for digital finance is rising continuously [37]. This kind of FDI not only attracts capital, but also promotes domestic technological upgrading through training and transformation, and the resulting intraindustry competitive effect promotes technological innovation.

Second, digital finance supports industrial restructuring. On the one hand, inefficient models of economic growth have many risks while achieving rapid economic growth. Using the funds provided by digital finance to transfer high-energy-consuming industries to low-carbon industries with high profit margins and high added value in a timely manner to complete the industrial structure upgrade is the best choice for pursuing future profits. On the other hand, adjusting the industrial structure can establish a good image of actively undertaking social responsibilities. Reputation will have a great impact on corporate decision-making [38], and actors will be motivated to build a better reputation under the premise of maximizing benefits [39]. Investing in environmentally friendly projects helps to establish a good social image, and the reputation effect can strive for long-term and stable financing opportunities and indirectly realize the upgrading of industrial and energy structures.

Third, digital finance encourages consumer participation. Environmental behavior in daily life is related to this situation [40]. For a long time, the general public has not fully implemented the concept of energy conservation and emission reduction due to limited implementation channels. The application of intelligent mobile devices and digital finance digitizes personal environmental protection achievements. The most typical example is the Ant Forest section launched by China's Alipay through the establishment of personal 'Carbon Accounts', which concretize carbon emission reduction behavior into a certain amount of energy and encourage daily low-carbon behavior. For example, according to the use of some forms of public transportation, a benefit is realized by using Alipay to pay for this one low-carbon behavior, and there are successive rewards of certain grams of energy, as various low-carbon behavior corresponds to different grams of energy. Users can also plant virtual trees with personal nameplates through energy harvesting; at the same time, in the desert, a real tree is planted. This campaign set off a craze known as 'Planting Trees for All'. Data from the Ant Group 2020 Sustainability Report (Source: https://www.antgroup.com/news-media/media-library, accessed on 18 June 2021) show that, as of December 2020, more than 550 million people had participated in Ant Forest activities, 220 million trees were planted on more than 3 million acres of land in Inner Mongolia, Gansu, and other regions, and emissions were reduced by more than 12 million tons. Digital finance also uses technical means to realize the online processing of traditional businesses, reducing the use of paper products.

In view of the above analysis, we therefore propose:

Hypothesis 2 (H2). *The development of digital finance inhibits the growth of carbon emissions.*

3. Data and Methodology

This paper uses balanced panel data composed of 30 provinces (autonomous regions and municipalities directly under the central government) in China from 2011 to 2018 as the research sample. The reason is that it is difficult to obtain data in the Hong Kong, Macao, and Taiwan regions in China, some data in the Tibet Autonomous Region are missing, and it is difficult to make more scientific data compensation through data processing technology. Thus, the data of the above four regions are eliminated. This article is dedicated to exploring the relationship between China's digital finance and carbon emissions and verifying whether policy changes have a certain effect on the relationship between the two.

3.1. Carbon Emission Calculation and Evolution Trend Analysis

In this paper, the calculation method of CO_2 emissions published in the reference method of Volume II of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the practice process of Gu et al. [41], Chen et al. [42], and Zhang et al. [43] is used to estimate the annual carbon emissions of each region, selecting eight types of fossil fuels to comprehensively calculate the carbon emissions of each region: coal, coke, crude oil, gasoline, kerosene, diesel, natural gas, and fuel oil. The calculation process does not include electricity consumption. The reason is that most of China's electricity is generated from thermal power generation. Although the application of new power generation methods, such as wind energy, solar energy, and nuclear energy, has played a part in reducing carbon emissions in recent years, thermal power, which mainly consumes fossil fuels, still accounts for a very large proportion of power generation. Eliminating the power factor can avoid double counting.

The method for estimating CO_2 emissions is as follows:

$$CO_{2it} = \sum_{i=1}^{8} CO_{2itj} = \sum_{i=1}^{8} M_{itj} \times K_j \times q_j \times \frac{44}{12} \tag{1}$$

where i is the province, t is the year, and j is various types of energy. CO_{2it} represents the annual carbon dioxide emissions of each province, which is the sum of the CO_2 emissions of eight types of energy in province i in t; M_{itj} represents the physical quantity of energy consumption of type j in province i in t; K_j is the reference coefficient for the conversion of type j energy into standard coal, taken from the China Energy Statistical Yearbook; q_j is the carbon emission coefficient of the j-th energy, and the data source is IPCC published data; and the constant 44/12 is the molecular weight ratio of CO_2 to C. This article assumes that all fossil fuels have been fully burned.

3.2. Variable Measurement and Sample Descriptive Characters

The independent variable is digital finance, which is derived from the Digital Financial Inclusion Index of China, compiled by the Institute of Digital Finance Peking University. It includes a comprehensive digital financial inclusive index and three primary dimensions with different focuses, namely the coverage breadth of digital finance, usage depth of digital finance, and digitization level of inclusive finance. Among them, the coverage breadth of digital finance measures the feature where the supply of digital financial services breaks through the limitation of regional space; the usage depth of digital finance represents the actual use of digital financial services; and the digitization level of inclusive finance emphasizes the inclusiveness of digital financial services.

The dependent variable is CO_2 emissions. China has not yet released official carbon emissions data, and a review of relevant documents found that there are differences in the calculation methods of carbon emissions. This article consults many related documents on carbon emission calculations and adopts the carbon emission calculation formula given by the Intergovernmental Panel on Climate Change (IPCC), which is a more accepted method. The calculation process is shown in Section 3.1.

The control variables are selected on the basis of reviewing the literature and combining the actual conditions. Four variables are selected: the scale of financial development, GDP [44], intellectual property protection, and industrial structure [43]. There is a close relationship between financial development and economic growth [45], so this paper uses the scale of financial development to represent the strength of the financial industry in various regions to drive economic development; regional GDP is an intuitive expression of the development of regional industries; intellectual property is the competitiveness and core value of market participants, and the protection of intellectual property gives a subject the exclusive right to use intangible assets for commercialization within a certain period of time [46], so the purpose of setting variable intellectual property protection is to clarify the differences in the strength of intellectual property protection in regions; and industrial structure is based on changes in the contribution of the tertiary industry to regional GDP calculations.

Table 1 Panel A details the names, definitions, measurements, sources, and data descriptions of the main variables in this article. Table 1 Panel B not only shows the differences between variables but also shows the characteristics of the variables themselves. Among them, the standard deviations of the variables CO_2 and GDP are very large, and there are large differences in carbon emissions and economic development levels among regions. Observing the digital financial inclusion index and the three-dimensional index, it is found that more than half of the regions have a relatively high level of digital finance development, and digital financial services have achieved relatively good promotion in various regions of China. Similar situations exist in the variables Industry and IP. In comparison, the scale of financial development of half of the regions is still at a low level.

Table 1. Variable definitions and summary descriptions.

Panel A: Variable Definitions			
Variable	**Definition**	**Measurement**	**Source**
CO_2	CO_2 emissions	$CO_{2it} = \sum_{i=1}^{8} CO_{2itj} = \sum_{i=1}^{8} M_{itj} \times K_j \times q_j \times \frac{44}{12}$, please refer to Section 3.1 for details.	China Energy Statistical Yearbook, IPCC Guidelines for National Greenhouse Gas Inventories
Digit	Peking University Digital Financial Inclusion Index of China (PKU-DFIIC)	An aggregate index constructed by integrating the coverage breadth, usage depth, and the digitization level of the Digital Financial Inclusion Index of China. Please refer to Reference 'Measuring China's Digital Financial Inclusion: Index Compilation and Spatial Characteristics' for the specific calculation method of the index.	A research team from the Institute of Digital Finance at Peking University and Ant Group
Cover	Coverage breadth of digital finance	Taking coverage rate as a subindex of Cover, which shows that it breaks through the limitation of regional space. The calculation method refers to the above article.	Source is the same as the previous variable
Depth	Usage depth of digital finance	According to the actual use of digital financial services, it includes both the total volume index and the activity index. The calculation method refers to the above article.	Source is the same as the previous variable
Level	Digitization level of inclusive finance	Digital financial services have the advantages of low cost and low threshold. The calculation method refers to the above article.	Source is the same as the previous variable
Industry	Industrial structure	Output value of regional tertiary industry/regional GDP	China Statistical Yearbook
Finance	Scale of financial development	(balance of deposits in financial institutions + balance of loans in financial institutions)/GDP	Wind financial terminal
GDP	Regional GDP	The data are calculated and obtained by the National Bureau of Statistics and the statistics bureaus of all provinces, autonomous regions, and municipalities directly under the central government.	China Statistical Yearbook
IP	Intellectual property protection (IPR)	(research and development funds of industrial enterprises above designated size + technology market turnover)/GDP $\times$ 10,000	China Statistical Yearbook

Table 1. *Cont.*

Panel B: Summary Statistics of Main Variables						
Variable	**N**	**Mean**	**Min**	**Median**	**Max**	**SD**
CO_2	240	42,332.1	4421.85	31,750.9	150,500	30,150.9
Digit	240	188.186	18.3300	204.135	377.734	84.9797
Cover	240	167.934	1.96000	175.530	353.867	82.7221
Depth	240	183.526	6.76000	178.175	400.397	84.8825
Level	240	263.529	7.58000	294.333	453.660	116.651
Industry	240	0.45439	0.29675	0.44346	0.80982	0.09532
Finance	240	3.03531	1.51752	2.87749	7.57463	1.05330
GDP	240	23,639.0	1670.44	18,222.9	97,277.8	18,431.5
IP	240	0.02349	0.00260	0.01626	0.17255	0.02770

3.3. Model Specification

3.3.1. Linear Regression Model

The IPAT model is one of the classic models for studying the impact of human activities on the environment. However, this model reflects only the same proportional relationship and cannot test hypotheses [47]. There are serious limitations that make it difficult to reflect reality. Scholars such as Dietz improved and proposed the SPIRPAT model on the basis of the IPAT model, which overcomes some of the shortcomings of the IPAT model to a certain extent. The expression of the SPIRPAT model is:

$$I = aP^b \times A^c \times T^d e \tag{2}$$

where a is the coefficient, b, c, and, d are the estimated indices of population, wealth, and technical level, respectively, and e is the random error term. The IPAT model is a special case where a, b, c, d, and e are all 1 in the SPIRPAT model. This model is widely used in research on the impact of carbon dioxide and other pollutants on the environment.

To study the effects of various factors on the environment more intuitively, Equation (2) is actually processed logarithmically to obtain the following equation:

$$\ln I = \ln a + b\ln P + c\ln A + d\ln T + e \tag{3}$$

where b, c, and d are the elastic coefficients of population, affluence, and technical level, respectively, lna is a constant term, and e is a random error term.

The research goal of this article is to explore whether digital finance has a positive or negative impact on China's carbon emissions. Carbon emissions are not a purely environmental issue and are affected by many factors, such as society, economy, and culture. Based on the actual situation, this paper introduces the scale of financial development, regional GDP, intellectual property protection, and industrial structure factors into the model and establishes the following panel model:

$$\ln CO_2 = a_i + b_1 \ln PKU - DFIIC(a,b,c)_{it} + b_2 \ln Controls_{it} + \mu_i + \theta_i + \epsilon \tag{4}$$

where CO_{2it} represents the CO_2 emissions of province i in China in year t, and PKU-DFIIC(a,b,c) is the digital financial inclusive index compiled by Peking University, with a total of three values. When taking a to represent the $Digit_{it}$ of province i in t years, take b as the $Cover_{it}$ of province i in year t, and take c as the $Depth_{it}$ of province i in year t. $Controls_{it}$ reflects other main variables that affect carbon emissions in province i at the provincial level in year t. μ_i controls the time fixed effect of year t, θ_i is the individual fixed effect of controlled province i, and ε is the random disturbance term. Refer to Appendix A for the summary statistics after the logarithmic processing of related variables.

3.3.2. Policy Effect Test

This article introduces three typical policy events to study the direction and strength of policy shocks on the relationship between digital finance and carbon emissions and whether policy guidance plays an expected role. The specific models are as follows:

$$\mathrm{lnCO_2} = \mathrm{a_i} + \mathrm{b_1 lnPKU} - \mathrm{DFIIC}(\mathrm{a,b,c,d})_{\mathrm{it}} \times \mathrm{Policy}(\mathrm{a,b,c})_{\mathrm{t}} + \mathrm{b_2 lnControls_{it}} + \mu_\mathrm{i} + \theta_\mathrm{i} + \epsilon \quad (5)$$

where there are three values of $\mathrm{Policy(a,b,c)_t}$, which represent the impact of three different policy events. When a is taken, it is the 11th G20 Hangzhou Summit in 2016 that adopted the G20 High-Level Principles for Digital Financial Inclusion; b means the Environmental Protection Tax Law of the People's Republic of China passed on 15 December 2016; and taking c means that in June 2012, the National Development and Reform Commission of China issued the Interim measures for the management of greenhouse gas voluntary emission reduction.

3.3.3. Nonlinear Regression Model

In addition, there are documents that indicate that there may be an Environmental Kuznets Curve relationship between carbon emissions and their influencing factors. Therefore, on the basis of constructing a linear regression model to test the relationship between digital finance and carbon emissions, this paper further investigates the existence of the inverted U-shaped relationship by referring to the method of York et al. [47]—that is, to introduce the quadratic term of digital finance into the model and use the difference generalized moment (Diff-GMM) model to estimate:

$$\mathrm{lnCO_2} = \mathrm{a_i} + \mathrm{b_1 lnPKU} - \mathrm{DFIIC}(\mathrm{a,b,c,d})_{\mathrm{it}} + \mathrm{b_2}(\mathrm{lnPKU} - \mathrm{DFIIC}(\mathrm{a,b,c,d})_{\mathrm{it}})^2 + \mathrm{b_3 lnControls_{it}} + \mu_\mathrm{i} + \theta_\mathrm{i} + \epsilon \quad (6)$$

Equation (6) expands the value of PKU-DFIIC to 4, and when d is taken, it represents the digitization level of inclusive finance in province i in year t ($\mathrm{Level_{it}}$).

4. Empirical Results and Analysis

4.1. Benchmark Regression Results

This paper adopts the unit root test method for short panel data proposed by Harris and Tzavalis (1999), and the results strongly reject the null hypothesis of the panel unit root. The results of Table 2 show that the growth of the digital financial inclusion index has a significant inhibitory effect on carbon emissions. Every 1% increase in the digital financial inclusion index will reduce carbon emissions by an average of 0.5712%. The coverage breadth of digital finance has no significant impact on carbon emissions. The estimated coefficient of the usage depth of digital finance on carbon emissions is significantly negative at a significance level of 1%, and carbon emissions are reduced by 0.8272% for every 1% increase. From the linear regression results, it is known that the overall growth of digital finance and the deepening of its use under actual use have a relatively obvious inhibitory effect on carbon emissions; that is, the development of digital finance will suppress carbon emissions, so Hypothesis 2 holds. Formula (4) examines the effects of the breadth and depth of the two-dimensional expansion of digital finance and comprehensive changes on emission reduction. The reason is that the variable Level emphasizes the changes in the degree of digitalization of inclusive finance, and the actual research subject still focuses on inclusive finance. This article pays more attention to the impact of digital finance, which is deeply integrated with finance and technology, on carbon emission reduction, so the variable Level is not included in the research system for the time being.

Table 2. Linear regression model of the effect of digital finance on carbon emissions.

Variables	**(1)**	**(2)**	**(3)**
		lnCO_2	
lnDigit	−0.5712 **		
	(0.237)		
lnCover		0.0021	
		(0.105)	
lnDepth			−0.8272 ***
			(0.158)
lnIndustry	−0.4063	−0.6281 *	−0.1809
	(0.333)	(0.329)	(0.318)
lnFinance	−0.1856	−0.2687	−0.1448
	(0.211)	(0.212)	(0.200)
lnGDP	0.7446 ***	0.6819 ***	0.8490 ***
	(0.059)	(0.056)	(0.060)
lnIP	−0.1896 ***	−0.1961 ***	−0.2218 ***
	(0.058)	(0.058)	(0.055)
Constant	5.1087 ***	2.6958 ***	5.3810 ***
	(1.374)	(1.030)	(1.037)
N	240	240	240
R^2	0.595	0.584	0.629
Province FE	YES	YES	YES
Year FE	YES	YES	YES

Note: Robust standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 0.1, 0.05, and 0.01 levels, respectively.

4.2. Policy Shocks

This article selects three policies that were developed in different years and are oriented to different subjects for targeted research. They are: ① the National Development and Reform Commission of China's Interim measures for the management of greenhouse gas voluntary emission reduction issued in 2012 to regulate and guide the process of voluntary emission reduction trading activities for six greenhouse gases; ② the 2016 G20 Hangzhou Summit promoted by China to formulate the world's first guiding principles for the digital economy, the G20 High-Level Principles for Digital Financial Inclusion, was officially adopted on 5 September 2016, providing experience and reference for the progress of digital finance in the world economy; and ③ the Environmental Protection Tax Law of the People's Republic of China (abbreviated as: Environmental Tax) was passed at the 25th Session of the Standing Committee of the 12th National People's Congress of the People's Republic of China on 25 December 2016, and China's environmental tax collection was officially put on the agenda. This article takes dummy variables based on the year of promulgation. Among them, the Interim measures for the management of greenhouse gas voluntary emission reduction takes 2011 as 0, and the remaining years take 1; the G20 High-Level Principles for Digital Financial Inclusion take 2016–2018 as 1, and the remaining years take 0; and the Environmental Protection Tax Law is passed at the end of the year, so when the dummy variable is used, the year is extended by one year. Therefore, the Environmental Tax is set to 1 for 2017–2018 and 0 for the rest of the year. The results of the study are shown in Table 3.

Table 3. Linear regression model estimation results of the effect of digital finance on carbon emissions under policy guidance.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	lnCO$_2$								
lnIndustry	−0.1945	−0.4898	−0.0571	−0.4685	−0.5365 *	−0.4679	−0.5493 *	−0.5754 *	−0.5490 *
	(0.335)	(0.341)	(0.304)	(0.315)	(0.323)	(0.303)	(0.316)	(0.321)	(0.308)
lnFinance	−0.1674	−0.2356	−0.1211	−0.2045	−0.2196	−0.2029	−0.2043	−0.2205	−0.2077
	(0.206)	(0.212)	(0.192)	(0.204)	(0.209)	(0.196)	(0.206)	(0.210)	(0.201)
lnGDP	0.7833 ***	0.7069 ***	0.8871 ***	0.7434 ***	0.7104 ***	0.7719 ***	0.7288 ***	0.7063 ***	0.7449 ***
	(0.059)	(0.057)	(0.057)	(0.054)	(0.055)	(0.052)	(0.054)	(0.055)	(0.053)
lnIP	−0.1794 ***	−0.1870 ***	−0.1859 ***	−0.1855 ***	−0.1909 ***	−0.1771 ***	−0.1917 ***	−0.1956 ***	−0.1857 ***
	(0.057)	(0.058)	(0.053)	(0.056)	(0.058)	(0.054)	(0.057)	(0.058)	(0.055)
lnDigit_Gas	−1.5107 ***								
	(0.404)								
lnCover_Gas		−0.3626							
		(0.290)							
lnDepth_Gas			−1.6604 ***						
			(0.236)						
lnDigit_G20				−2.7017 ***					
				(0.666)					
lnCover_G20					−1.3165 **				
					(0.587)				
lnDepth_G20						−2.4999 ***			
						(0.423)			
lnDigit_Tax							−2.8116 ***		
							(0.775)		
lnCover_Tax								−1.6394 **	
								(0.762)	
lnDepth_Tax									−2.4194 ***
									(0.493)
Constant	9.0075 ***	4.2080 ***	8.6719 ***	7.8658 ***	5.1827 ***	7.1815 ***	6.2353 ***	4.7452 ***	5.5580 ***
	(1.924)	(1.534)	(1.213)	(1.572)	(1.455)	(1.169)	(1.346)	(1.340)	(1.078)
N	240	240	240	240	240	240	240	240	240
R^2	0.608	0.587	0.659	0.612	0.593	0.640	0.607	0.593	0.624
Province FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: Robust standard errors are reported in parentheses; *, **, *** are significant at the 10%, 5%, and 1% levels, respectively.

The results of Columns 1–3 of Table 3 indicate the impact of the Interim measures for the management of greenhouse gas voluntary emission reduction on the relationship between the independent variable and the dependent variable. Observing the change in the coefficient value, it is found that the increase in the digital financial inclusion index and the increase in the actual depth of use significantly enhance the suppression of carbon emissions. The variable Digit_Gas's regression coefficient on carbon emissions became significant at a significance level of 1%; although the increase in coverage beyond space restrictions has an inhibitory effect on carbon emissions, it is still not significant. Table 3 Columns 4–6 are the research on the impact of the G20 Hangzhou Summit on the utility of digital finance. The results show that after the promulgation of the G20 High-Level Principles for Digital Financial Inclusion, the value of the coefficient of digital finance on carbon emissions changes significantly, the suppression effect is significantly enhanced, and the coefficient of coverage breadth for carbon emissions is not only negative but also significant at the 5% significance level. The results of Columns 7–9 of Table 3 are listed as the impact of the Environmental Protection Tax Law on the relationship between the independent variables and the cause. The results presented are similar to the influence of the G20 Hangzhou Summit on the relationship between dependent variables and independent variables. An important change compared with the benchmark effect is that the coverage breadth of digital finance increases significantly to curb carbon emissions.

4.3. Further Test: Nonlinear Regression

This paper uses Formula (6) to verify the existence of the inverted U-shaped curve, and the results are shown in Table 4. The results in Table 4 show that there is an inverted U-shaped relationship between the digital financial inclusion index and carbon emissions. After the digital financial inclusion index takes the logarithm, it obviously contributes to carbon emissions on the left side of the threshold value of 0.4375 and hinders the continuous growth of carbon emissions on the right side of the threshold value. However, carbon emissions show a significant monotonic decline in the range of digital financial coverage and depth of use. To explore why the digital financial composite index's effect on carbon emissions first promotes and then suppresses, this article adds the variable PKU-DFIIC in Formula (4) to the fourth value, the digitization level of inclusive finance (named Level), and determines its effect on carbon emissions. The effect of emissions increases monotonically within the value range, and the year-on-year increase in Level not only does not suppress carbon emissions but also significantly increases carbon emissions.

Table 4. Nonlinear regression model estimation results of the effect of digital finance on carbon emissions.

Variables	**(1)**	**(2)**	**(3)**	**(4)**
	$lnCO_2$			
lnDigit	37.7068 **			
	(14.664)			
zlnDigit2	−8.2493 ***			
	(2.658)			
lnCover		−17.3855 ***		
		(5.976)		
zlnCover2		−4.0810 ***		
		(1.406)		
lnDepth			−9.8570 ***	
			(2.667)	
zlnDepth2			−2.0546 ***	
			(0.556)	
lnDigitlevel				31.2911 ***
				(11.245)
zlnDigitlevel2				8.4094 ***
lnGDP	−6.7346 **	1.8035 ***	1.8822 ***	2.2311 ***
	(2.750)	(0.380)	(0.334)	(0.538)
lnIndustry	−61.5501 ***	−0.3460	−1.2225 **	−12.5579 ***
	(22.164)	(0.483)	(0.582)	(4.227)
lnFinance	5.7914 ***	1.4512 ***	1.9175 ***	10.7827 ***
	(2.012)	(0.538)	(0.705)	(3.870)
lnIP	3.8121 ***	1.3577 **	0.4320	−1.2268 ***
	(1.423)	(0.553)	(0.395)	(0.370)
Constant	−90.8870 **	81.3974 ***	45.3093 ***	−200.3045 ***
	(39.082)	(26.948)	(13.445)	(72.573)
AR(2) test (p value)	0.9973	0.0541	0.6822	0.4604
N	224	224	224	224
Province FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Note Robust standard errors are reported in parentheses; **, *** are significant at the 5%, and 1% levels, respectively.

The results obtained in this paper are not difficult to explain in combination with the actual situation of China's digital finance. The advancement of the depth and breadth of digital finance emphasizes the enhancement of the availability and convenience of financial services and financial products, encourages the pursuit of quality development or quality of life by easing credit constraints on groups or individuals, and achieves progress in capital acquisition and ideological heights. However, the digitization level of inclusive finance emphasizes the use of technological means to achieve greater financial inclusiveness. Inclusiveness means focusing on providing financial services to disadvantaged groups under the premise of affordable costs, improving social equity, and obtaining funds from scratch. Therefore, investment entities are more inclined towards heavy industries with high investment returns but also serious environmental pollution or the consumption of high energy-consuming products, which increase carbon emissions. The coverage breadth and usage depth of digital finance inhibit carbon emissions, and the degree of digitization level of inclusive finance promotes carbon emissions. The combined effect of different regions and influences is represented by an inverted U-shaped curve. This article focuses on the technological means for the overall financial change of digital financial-related impact on carbon emissions, rather than the impact of technological development on inclusive financial support and on carbon emissions. Therefore, from the perspective of the objects studied in this article, digital finance actually restrains carbon emissions, further verifying the existence of Hypothesis 2.

5. Placebo Test

The placebo test is inspired by medicine. The basic principle is to construct pseudopolicies to test whether the results based on policy effects are reliable; that is, it is suspected that the estimated results derived from policy effects may not be due to policy shocks but are generated by other unobserved or unobservable factors. Placebo inspection will be necessary to rule out this possibility. The potential threat of the conclusion of this paper is that the reduction of carbon emissions may be the result of eliminating some market participants in the struggle for survival under the market mechanism. To exclude the possibility that the empirical results mentioned above are caused by other unobserved or unobservable factors, the placebo test is conducted by constructing a randomized treatment group.

This article draws on the method of Cantoni et al. [48] and Chetty et al. [49], combined with the relevant research of Liu et al. [50], to conduct a placebo test. The independent variables related to the policy are the interaction term of three indicators of digital finance and three policies, and nine variables are constructed. The treatment group of 1000 simulations was randomly allocated using Stata15-related programs, and the t value was calculated and plotted in the statistical distribution diagram. This process resulted in a total of nine diagrams. The result is shown in Figure 1, where the red line perpendicular to the x axis is the position in the distribution of the t statistic of the real policy effect. The three in each row in the figure below are a group, corresponding to the crossover items of digital finance and the three policies. The order corresponds to the order of the independent variable and the policy in Table 3. Observing the results of the distribution graph, it is found that the t values are all in an inverted U shape and most of the values are concentrated near 0. Only a few regressed t values are greater than the t values of the regression coefficients in Table 3, and even the t values in the third column of Figure 1 are all less than the real regression t values. The virtual independent variables of the interaction term have no treatment effect on carbon emissions, and the real policy effects do promote the suppression of carbon emissions by digital finance. There is a significant difference between the results obtained by the placebo test and the results obtained by the real policy effects, confirming that the results of Table 3 in this article are not accidental, and the interference of other unobserved factors or unobservable factors on the results is excluded.

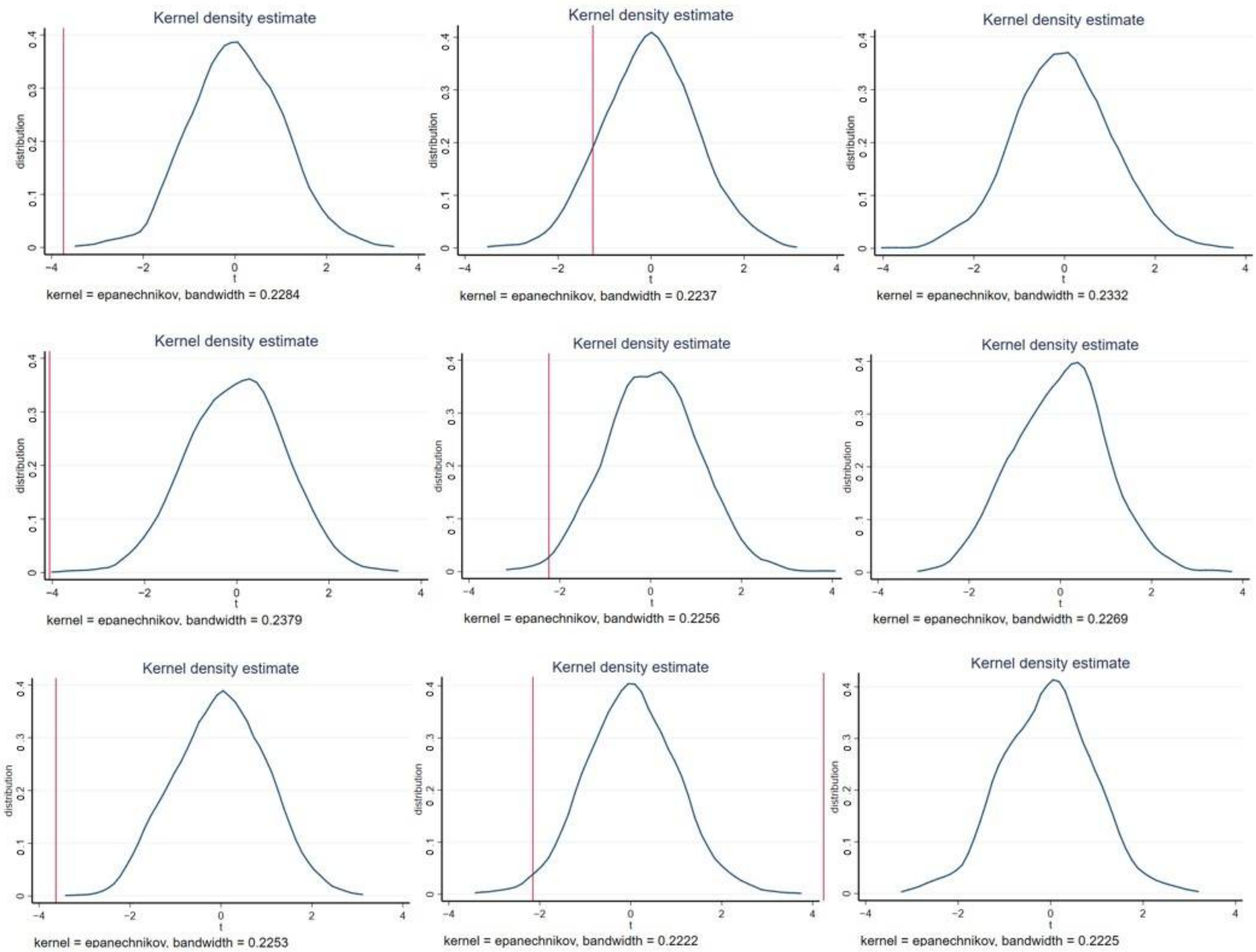

Figure 1. Results of placebo test.

6. Heterogeneity Test

The data used in the first half of this article are all interprovincial panel data. China is a large country, and various provinces have large differences in natural resources, humanities and customs, economic development, etc. In particular, the eastern, central, and western regions have differences in location factors that are difficult to reconcile in the short term, which is typically reflected in the uneven duality of the region. The eastern coastal areas develop rapidly, while the inland areas, especially the western areas, lag behind [51]. Whether the previous results differ in regions with different levels of economic development, it is of practical significance to consider the influence of regional factors on the relationship between the dependent variable and the independent variable.

This paper separates the eastern, central, and western provinces from the total sample according to the geographic location of the provinces and performs a regional regression. The regression results are shown in Table 5. The first three columns in Table 5 show the estimation results of the western region. The three indicators of digital finance have no significant impact on carbon emissions, and the increase in the digital financial inclusion index and coverage breadth has a positive effect on carbon emissions. Compared with other regions, the western region is still in a period of accelerated economic growth, and the awareness of energy conservation and emission reduction is weaker. Columns 4–6 of Table 5 are the estimation results of the central region. Compared with the estimated coefficients of Digit and Depth in the western region, it has an obvious carbon emission inhibition effect, but the expansion of Cover did not significantly inhibit carbon emissions in the central region. Columns 7–9 of Table 5 are the regression results of the eastern region, and the three digital financial indicators have a significant inhibitory effect on carbon emissions. The maturity of digital finance in the eastern region is ahead of other regions in all aspects, and the level of economic development is relatively high. Its development process removes the constraint of the external environment on the implementation of the pursuit of high-quality economic thinking, so the growth of digital finance has highlighted the inhibitory effect of carbon emissions.

Table 5. Estimation results of the effect of digital finance on carbon emissions in regions with different development situations.

Variables	(1)	(2) Western Region	(3)	(4)	(5) Central Region $lnCO_2$	(6)	(7)	(8) Eastern Region	(9)
lnDigit	0.2127			−1.8250 ***			−1.4137 ***		
	(0.454)			(0.669)			(0.384)		
lnCover		0.1898			0.1421			−0.6774 ***	
		(0.144)			(0.284)			(0.240)	
lnDepth			−0.1161			−0.8784 ***			−1.2389 ***
			(0.259)			(0.198)			(0.344)
lnIndustry	1.3065 **	1.3685 **	1.2734 *	1.8221 ***	1.7157 ***	1.5562 ***	−1.6197 **	−1.8902 ***	−1.4790 **
	(0.654)	(0.647)	(0.650)	(0.354)	(0.382)	(0.324)	(0.617)	(0.627)	(0.629)
lnFinance	−1.6899 ***	−1.6650 ***	−1.6476 ***	2.8356 ***	2.5743 ***	2.3852 ***	0.2345	0.1539	0.2453
	(0.376)	(0.373)	(0.388)	(0.257)	(0.275)	(0.228)	(0.305)	(0.313)	(0.307)
lnGDP	0.3121 ***	0.3089 ***	0.3586 ***	1.3292 ***	1.2201 ***	1.2166 ***	0.9375 ***	0.8870 ***	0.9997 ***
	(0.094)	(0.087)	(0.107)	(0.129)	(0.134)	(0.113)	(0.082)	(0.081)	(0.090)
lnIP	−0.1423 *	−0.1455 *	−0.1438 *	−0.3579 ***	−0.5259 ***	−0.3195 ***	−0.0494	−0.0088	−0.1138
	(0.084)	(0.083)	(0.085)	(0.107)	(0.098)	(0.093)	(0.086)	(0.089)	(0.090)
Constant	8.5733 ***	8.7693 ***	9.6853 ***	4.2236	−5.1067 **	0.9250	6.7304 ***	3.3956 **	5.0589 ***
	(2.414)	(1.596)	(1.615)	(3.539)	(2.024)	(1.843)	(2.050)	(1.573)	(1.716)
N	88	88	88	64	64	64	88	88	88
R^2	0.580	0.589	0.580	0.751	0.716	0.794	0.878	0.870	0.878
Province FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: Robust standard errors are reported in parentheses; *, **, *** are significant at the 10%, 5%, and 1% levels, respectively.

In order to further verify the causal relationship between the development of digital finance and CO_2 emissions and the influence of external environmental factors on the relationship between them, this paper further discusses the classification based on the regional per-capita GDP (perGDP), and the results are shown in Appendix B.

7. Conclusions and Suggestions

7.1. Conclusions

Digital finance is widely regarded as a new force contributing to the transformation and upgrading of China's economic growth mode. Based on balanced panel data at the provincial level from 2011 to 2018, this article examines the relationship between digital finance and carbon emissions, as well as the impact of exogenous policy events. The main conclusions are as follows.

First, the digital financial inclusion index and the usage depth of digital finance have a significant inhibitory effect on carbon emissions, and the coverage breadth has no significant inhibitory effect on carbon emissions. The application of digital finance can improve the financing constraints faced by various carbon emission reduction methods, such as technological transformation, and timely policy issuance to guide funds in terms of flow and application is more inclined to reduce carbon emissions rather than increase carbon emissions. Therefore, digital finance has a significant inhibitory effect on carbon emissions. The proof of the inhibitory effect of digital finance on carbon emissions shows the positive role of digital finance as a new financial format, and provides a new reference path for facilitating environmental protection.

Second, the digitization level of inclusive finance plays a significant role in promoting carbon emissions. This conclusion is reached by testing the sub-indices of digital finance from different angles, which provides evidence for the inverted U-shaped result of the relationship between digital finance and carbon emissions obtained from the non-linear test, and refines the previous research conclusions. At present, the application of inclusive finance produced by technological progress is mainly concentrated in underdeveloped regions or industries. The beneficiary regions or industries are more inclined to apply funds to heavy industries with serious pollution but high short-term investment returns. Therefore, the current digitization level of inclusive finance has a positive effect on carbon emissions; it has not yet reached the stage of suppressing carbon emissions, but the possibility of transitioning to the stage of suppressing carbon emissions cannot be ruled out in the future.

Third, we select three main policies that affect digital finance or carbon emissions and empirically test the possible impact of policy events on the relationship between digital finance and carbon emissions. The results show that exogenous policy events can further enhance the suppression of carbon emissions by digital finance. A further placebo test showed that the result of the policy in helping digital finance to curb carbon emissions was not accidental, and the interference of other unobserved factors or unobservable factors with the results was excluded. This paper affirms the positive role of policies in the suppression of carbon emissions by digital finance.

Fourth, from the eastern region to the central region to the western region of China, the suppression of carbon emissions by digital finance is gradually weakening, and there are regional differences in the effects of digital finance on carbon emissions. The inhibitory effect of digital finance on carbon emissions is significant in the more developed eastern and western regions, especially in the eastern region. The coefficients of the three independent variables are all significantly negative, and the coverage breadth of digital finance in the central region does not significantly inhibit carbon emissions. This paper confirms the existence of regional heterogeneity, and the role of digital finance on carbon emissions should be viewed in accordance with local conditions.

7.2. Proposals

First, it is necessary to vigorously support the development of digital finance and give full play to the vitality of digital finance. Digital finance is gradually integrating into all aspects of production and life due to its low threshold and easy operation. This article provides new empirical evidence for digital finance to suppress carbon emissions, reflecting, to a certain extent, that digital finance is a new way to reduce carbon emissions. Countries or regions should combine their own development status and make full use of their advantages, strive to break the obstacles to the development of digital finance, and fully release the positive role of digital finance in carbon emission reduction. At the micro level, financial market participants, especially companies engaged in high-polluting industries, can use digital finance as a new funding channel to complete technology and equipment upgrades in a timely manner in order to reduce the environmental damage caused by pollutants such as carbon dioxide.

Second, it is necessary to formulate and implement relevant policies. The forward-looking and guiding role of the top-level policy design of the Chinese government is evident in the suppression of carbon emissions by digital finance in this article. To a certain extent, it shows that timely and appropriate digital finance development policies can strengthen the positive impact of digital finance. It is also necessary to promote it to all countries and regions. On the one hand, environmental protection departments and policy-making departments need to formulate stricter measurement standards and punitive measures for environmental damage; on the other hand, the two departments should not be limited to unilateral concerns about environmental protection. It is more important to find the source of environmental protection behaviors. The findings of this paper remind the above two departments to strengthen cooperation with digital finance regulatory authorities, jointly formulate relevant policies to promote the high-quality development of digital finance, and use policy means to guide digital finance to inhibit carbon emissions.

Finally, when developing digital finance, we must pay attention to the differences among regions. The application of digital finance in different regions has different performances. Each country or region can guide digital finance to suppress carbon emissions and formulate differentiated policies based on local conditions. In underdeveloped regions, this paper points out that digital finance has insufficient restraint on carbon emissions, and other ways to reduce carbon emissions should be actively sought. In more developed regions, digital finance has a very significant inhibitory effect on carbon emissions. Policy formulation should focus on removing the development barriers of digital finance while supporting other ways to reduce carbon emissions, so as to drive digital finance to better play an active role in carbon emission reduction.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Logarithmization results of variables.

Summary Statistics of Each Main Variable after Logarithmic Processing						
$lnCO_2$	240	10.3942	8.39431	10.3657	11.9217	0.76350
lnDigit	240	5.07295	2.90854	5.31878	5.93419	0.66991
lnCover	240	4.90371	0.67294	5.16781	5.86892	0.83220
lnDepth	240	5.05779	1.91102	5.18277	5.99246	0.64418
lnLevel	240	5.39227	2.02551	5.68471	6.11735	0.73352
lnIndustry	240	−0.80808	−1.21487	−0.81316	−0.21095	0.19170
lnFinance	240	1.06185	0.41708	1.05692	2.02480	0.30036
lnGDP	240	9.76737	7.42084	9.81042	11.4853	0.84292
lnIP	240	−4.11060	−5.95339	−4.11886	−1.75704	0.79886

Appendix B

Table A2. Estimation results of the effect of digital finance on carbon emissions in regions with different regional per-capita GDP.

Variables	(1)	(2) lnCO$_2$	(3)	(4)	(5) lnCO$_2$	(6)
		Low perGDP Area			High perGDP Area	
lnDigit	−0.5885			−2.2630 ***		
	(0.362)			(0.554)		
lnCover		0.0811			−1.2590 ***	
		(0.132)			(0.466)	
lnDepth			−0.7061 ***			−2.5412 ***
			(0.184)			(0.382)
lnIndustry	0.8567 *	0.7527	1.1158 **	−0.1242	−0.3736	0.3180
	(0.479)	(0.482)	(0.457)	(0.746)	(0.776)	(0.672)
lnFinance	0.6646 **	0.6679 **	0.6099 **	0.2349	0.0754	0.5516 *
	(0.325)	(0.329)	(0.306)	(0.357)	(0.380)	(0.321)
lnGDP	0.9376 ***	0.8844 ***	1.0498 ***	0.7974 ***	0.7208 ***	0.9373 ***
	(0.095)	(0.093)	(0.095)	(0.096)	(0.097)	(0.090)
lnIP	−0.0165	−0.0073	−0.0704	−0.1436	−0.1511	−0.1069
	(0.089)	(0.090)	(0.085)	(0.094)	(0.098)	(0.084)
Constant	4.3157 **	1.5929	3.8429 ***	13.7790 ***	9.0279 ***	14.0157 ***
	(2.024)	(1.439)	(1.372)	(3.011)	(2.674)	(2.195)
N	104	104	104	104	104	104
R^2	0.620	0.611	0.664	0.586	0.546	0.670
Province FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note: Standard errors are in (); *, **, *** are significant at the 10%, 5%, and 1% levels, respectively.

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